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Elizabeth A. Allen

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THE ADMISSIBILITY OF DNA EVIDENCE IN WASHINGTON AFTER *STATE v. CAUTHRON*

Elizabeth A. Allen

Abstract: In *State v. Cauthron*, the Washington Supreme Court issued its first opinion concerning forensic DNA evidence. The court clearly held that the principles underlying DNA evidence and the restricted fragment length polymorphism (RFLP) method of DNA typing are generally accepted in the scientific community and are therefore admissible under the *Frye* test. The court refused to find that the trial court had properly admitted DNA evidence, however, because testimony that the suspect's DNA "matched" the perpetrator's was not supported by probability statistics. This Note demonstrates that the court was unclear in its discussion of when probability statistics meet the *Frye* test, leaving other courts with little guidance. This Note thus proposes that courts should admit DNA evidence supported by conservative probability statistics.

*"The twofold aim of criminal justice is that guilt shall not escape or innocence suffer."*¹

With the introduction of deoxyribonucleic acid (DNA) typing evidence² into the process of criminal investigations in the mid-1980s,³ scientists and lawyers alike realized they had discovered a valuable evidentiary tool for differentiating the guilty from the innocent. The Washington Supreme Court scrutinized this tool in a case reviewing the DNA typing evidence (DNA evidence) admitted in a Snohomish County rape trial. In 1986 and 1987, an unknown criminal committed a series of 20–25 rapes in Everett, Washington.⁴ In each case, the rapist wore a mask and cloth gloves and carried a small black handgun.⁵ In 1988, the police arrested Richard Cauthron for these crimes.⁶ A search of the bushes where they found Cauthron revealed a ski mask, a pair of green

1. *United States v. Porter*, 618 A.2d 629, 640 (D.C. 1992) (quoting *Berger v. United States*, 295 U.S. 78, 88 (1935)).

2. DNA evidence usually comes from genetic material in hair, skin, blood, or semen found at crime scenes. DNA typing, for forensic purposes, involves comparing the genetic characteristics found in this evidence to the genetic characteristics of the suspect. *Fishback v. People*, 851 P.2d 884, 885 (Colo. 1993).

3. DNA typing was first used in casework in 1985 in the United Kingdom. It was first used by commercial labs in the United States in 1986. Committee on DNA Technology in Forensic Science, National Research Council, *DNA Technology in Forensic Science* 1 (1992) [hereinafter *DNA Technology*].

4. *State v. Cauthron*, 120 Wash. 2d 879, 882, 846 P.2d 502, 503 (1993).

5. *Id.* at 883, 846 P.2d at 503.

6. *Id.*, 846 P.2d at 504.

wool gloves, and a black gun that turned out to be a toy.⁷ In addition to these clues, some of the most convincing evidence against Cauthron came from the DNA in his own cells.⁸

*State v. Cauthron*⁹ is Washington's first supreme court opinion to address concerns about forensic DNA evidence. In *Cauthron*, the court held that the scientific principles underlying DNA evidence and the restricted fragment length polymorphism (RFLP) method¹⁰ of DNA typing are admissible.¹¹ The court reversed Cauthron's conviction, however, and remanded the case, because testimony that Cauthron's DNA matched the perpetrator's was not supported by interpretive probability statistics.¹²

This Note argues that portions of the court's analysis are confusing and fail to clearly guide other courts considering the admissibility of DNA evidence. Part I examines the two major components of RFLP DNA evidence: first, the underlying scientific principles and the processing method and, second, the probability statistics interpreting a match. Part I also examines the *Frye* test for the admissibility of scientific evidence, its adoption in Washington, and its application in and modification by *Cauthron*. Part II argues that the decision is unclear and contradictory when discussing admissibility of the statistical component of DNA evidence. Finally, part III contends that courts should fill the void left by *Cauthron*'s unclear guidance and admit DNA evidence when conservative probability statistics are employed.

I. DNA EVIDENCE AND THE *FRYE* TEST

Analysis of DNA evidence includes processing DNA samples from the suspect and the crime scene to determine if they match. Present technology does not allow for analysis of an entire DNA molecule.¹³ Therefore, scientists must determine the significance of a match by using

7. *Id.*, 846 P.2d at 503.

8. Jolayne Houtz, *DNA Evidence Faces Challenge—High Court to Air Rapist's Appeal*, Seattle Times, Sept. 18, 1991, at B1.

9. 120 Wash. 2d 879, 846 P.2d 502 (1993).

10. The RFLP method of analyzing DNA evidence, at issue in *Cauthron*, involves isolating highly variable segments of DNA using a restriction enzyme, separating the DNA fragments, and producing x-ray films which enable visualization of the lengths of the fragments. *People v. Barney*, 10 Cal. Rptr. 2d 731, 735–36 (Cal. Ct. App.), *rev. denied*, No. S028767, 1992 Cal. LEXIS 5924 (Cal. Nov. 25, 1992); *see also infra* notes 23–24 and accompanying text.

11. *Cauthron*, 120 Wash. 2d at 882, 846 P.2d at 503.

12. *Id.* at 909, 846 P.2d at 517.

13. *Id.* at 900, 846 P.2d at 512.

probability statistics. Methods for calculating these statistics are the prime source of controversy in the debate over the admissibility of DNA evidence. The *Cauthron* court was unclear in its discussion of when probability statistics meet the *Frye* test, and thus failed to provide clear guidance for other courts.

A. *The Components of and Controversy over DNA Evidence*

DNA is the active substance of the genes,¹⁴ and it determines an individual's inherited physical characteristics.¹⁵ Except for identical twins, each person's DNA structure is unique. DNA molecules contain approximately three billion base pairs, composed of the nucleic acid molecules adenine, thymine, guanine, and cytosine.¹⁶ A series of these base pairs that codes a protein is called a gene.¹⁷ The sequence of the base pairs determines each person's unique composition.¹⁸ Ninety-nine percent of the base pairs are the same for all people,¹⁹ giving each person two arms, two legs, a liver, a heart, and other common characteristics.²⁰ Other sections of DNA are highly variable (polymorphic).²¹ Genes in these polymorphic sections have two or more alternate versions called "alleles."²² Polymorphic genes determine hair color, eye color, and other characteristics which vary from person to person. The method of forensic DNA typing at issue in *Cauthron* involves isolating and comparing several highly polymorphic alleles through a process called restricted fragment length polymorphism (RFLP).²³

Analyzing RFLP DNA evidence consists of two integral components: 1) processing DNA from the suspect and the crime scene to see if any of the fragments from the two sources match, and 2) determining the match's statistical significance. The RFLP method of processing DNA

14. *DNA Technology*, *supra* note 3, at 2.

15. *Cauthron*, 120 Wash. 2d at 891-92, 846 P.2d at 508.

16. *Id.*

17. *State v. Lyons*, 863 P.2d 1303, 1307 (Or. Ct. App. 1993).

18. *Cauthron*, 120 Wash. 2d at 892, 846 P.2d at 508.

19. *Fishback v. People*, 851 P.2d 884, 886 (Colo. 1993).

20. *Cauthron*, 120 Wash. 2d at 892, 846 P.2d at 508-09.

21. Dan E. Krane et al., *Genetic Differences at Four DNA Typing Loci in Finnish, Italian, and Mixed Caucasian Populations*, 89 Proc. Nat'l Acad. Sci. USA 10,583 (1992).

22. *Fishback*, 851 P.2d at 886. The allele contributed by the father, for example, might be for blue eyes, while that contributed by the mother might be for brown.

23. *Id.* The polymerase chain reaction (PCR) method of DNA typing, an alternative to RFLP, is also being considered by courts. *State v. Lyons*, 863 P.2d 1303, 1307-08 (Or. Ct. App. 1993); *see also DNA Technology*, *supra* note 3, at 70.

evidence involves multiple steps that result in "autorads" or pictures of DNA which show bands of varying lengths.²⁴ A lab analyst visually compares the DNA patterns on the suspect's autorad to the patterns on autorads produced from biological crime scene material to determine whether or not the two match. If a visual match is determined, the bands are measured by computer analysis.²⁵ Because it is impossible to measure the fragments to the precise number of base pairs, a margin of error, known as a "match window," is built into the methodology.²⁶ Two fragments are considered to match if they differ in length by no more than a given percentage, such as 2.5 percent of their length in base pairs.²⁷

Once the lab finds a match, it must determine the statistical significance of that match. Although each person's DNA is unique when examined as a whole (with the exception of identical twins), present technology does not allow analysis of the entire length of the DNA molecule.²⁸ Testing only a fragment cannot guarantee absolute identification. Therefore, scientists determine the significance of a match by calculating how frequently a particular DNA profile appears by chance in the target population.²⁹ The statistical significance is expressed in terms of how likely it would be for a random person in that population to share the DNA profile evident in both the crime scene sample and the suspect.³⁰ For example, it might be estimated that the likelihood of a

24. The first step of RFLP processing is extracting DNA from the specimen (extraction). *People v. Barney*, 10 Cal. Rptr. 2d 731, 735 (Cal. Ct. App.), *rev. denied*, No. S028767, 1992 Cal. LEXIS 5924 (Cal. Nov. 25, 1992). The next step is cutting the DNA into fragments of varying lengths using an enzyme (restriction). *Id.* For sequences of DNA that are the same in all individuals, the restriction enzyme will cut everyone's DNA in the same place, resulting in fragments that are substantially the same length. *People v. Castro*, 545 N.Y.S.2d 985, 991 (Sup. Ct. 1989). In the polymorphic sequences, the length of the fragments varies because of the differing numbers of base pairs that lie between the cutting points selected by the restriction enzymes. *Id.* These repeat sequences of DNA base pairs which vary in length are known as variable numbers of tandem repeats (VNTRs). *Id.* The variable length fragments, cut by the enzyme, include these VNTRs and are known as restricted fragment length polymorphisms (RFLPs). *Id.*

Further steps consist of separating the fragments by length, transferring fragments onto a membrane and splitting them in half lengthwise ("southern transfer"), marking the fragments to be measured with radioactively marked probes (hybridization), and x-raying the membrane to make an autorad or picture of the DNA (autoradiography). *Barney*, 10 Cal. Rptr. 2d at 735-36.

25. *Barney*, 10 Cal. Rptr. 2d at 736.

26. *Id.*

27. *Id.*

28. *State v. Cauthron*, 120 Wash. 2d 879, 900, 846 P.2d 502, 512 (1993).

29. *Barney*, 10 Cal. Rptr. 2d at 736. The target population is determined by the defendant's race. *Id.*

30. *Fishback v. People*, 851 P.2d 884, 888 (Colo. 1993).

random match is one in 7.8 million.³¹ The lower the probability that another person could share the DNA pattern evident in the crime scene sample and the suspect, the greater the possibility that the crime scene sample did in fact come from the suspect.

The conventional method of estimating the probability of a match occurring by chance has been to multiply the frequencies with which the relevant variable alleles occur in a database of samples from the defendant's race.³² This method is known as the "product rule."³³ First, the lab calculates how frequently each allele (as it is depicted on an autorad) is found in the target population.³⁴ Then it calculates the frequency of the genotype,³⁵ or pair of alleles, at each locus³⁶ by multiplying the individual allele frequencies together.³⁷ Finally, it calculates the frequency for the complete multilocus genotype by multiplying the genotype frequencies at each loci tested.³⁸ For example, the pair of alleles at site *A* may be found in one of every ten people; the alleles at site *B* found in one of every 20; and alleles at site *C* in one of five. Using the product rule, experts can multiply ($1/10 \times 1/20 \times 1/5$) to achieve the result that only one person in every 1,000 will match all three sites.³⁹

The precise accuracy of the product rule depends on whether the events multiplied are truly statistically independent. Potential problems with a lack of independence can be illustrated with a simple example. If a population survey of Europe showed one in ten people had red hair, one in ten had freckles, and one in ten had fair skin, it would be wrong to multiply these frequencies to conclude the frequency of people with all three characteristics was one in 1,000, because they are not necessarily independent characteristics.⁴⁰ If the possibility of having these traits is

31. *Barney*, 10 Cal. Rptr. 2d at 737.

32. *Krane*, *supra* note 21, at 10,583.

33. *State v. Cauthron*, 120 Wash. 2d 879, 901, 846 P.2d 502, 513 (1993).

34. *Fishback*, 851 P.2d at 888. The lab does this by categorizing each band by length, according to a range of base pair lengths, called a bin. It then determines how often bands within that bin occur in the target population. *Id.*

35. A "genotype" refers to a genetic composition, *DNA Technology*, *supra* note 3, at 169 (here, a particular combination of two alleles).

36. A "locus" is the specific physical site of a gene on a chromosome. *DNA Technology*, *supra* note 3, at 170.

37. *Fishback*, 851 P.2d at 888.

38. *DNA Technology*, *supra* note 3, at 11.

39. *State v. Cauthron*, 120 Wash. 2d 879, 901, 846 P.2d 502, 513 (1993).

40. *DNA Technology*, *supra* note 3, at 76; *see also Cauthron*, 120 Wash. 2d at 901-02, 846 P.2d at 513.

interrelated, then anyone who has one is more likely to have the others, and multiplication is not valid.

Two central assumptions involved in product rule statistics have provoked debate in the scientific community. First, the Hardy-Weinberg equilibrium assumption assumes that the two alleles at each loci (one from the father and one from the mother) are independent.⁴¹ Second, the linkage equilibrium assumption assumes that the various loci tested are not related.⁴² The debate centers around the significance and effect of population substructure within databases used to estimate allele frequencies. Some scientists maintain that population substructure exists, because ethnic subgroups tend to mate with persons of like religion, ethnicity, and geographic area.⁴³ Such selective mating, they say, maintains genetic differences or "substructuring" among subgroups.⁴⁴ Specifically, substantial differences may exist between allele frequencies within the subgroups and allele frequencies in the databases.⁴⁵ If significant substructure exists, it would be inappropriate to use broad databases (databases representing multiple subgroups) to estimate allele frequencies and inappropriate to multiply frequencies, for lack of independence.⁴⁶ To summarize the disagreement, some scientists maintain that significant population substructure may exist and lead to major inaccuracies in frequency calculations.⁴⁷ Others maintain that population substructure within the databases has a "trivial" effect on the reliability of frequency estimates that "cannot be detected in practice."⁴⁸

41. *Fishback*, 851 P.2d at 888.

42. *Id.*

43. *People v. Barney*, 10 Cal. Rptr. 2d 731, 740 (Cal. Ct. App), *rev. denied*, No. S028767, 1992 Cal. LEXIS 5924 (Cal. Nov. 25, 1992).

44. *Id.*

45. *Id.* (A given allele may be common in some subgroups but not in the broader database).

46. *Id.* To illustrate with a hypothetical example: assume a specific ethnic minority made up ten percent of a database, the minority group members all shared the same allele at each of three loci tested, and the particular alleles were absent in the other populations contained in the database. In this case, a study of the database would show that each minority allele had a frequency of ten percent. Applying the product rule, the probability of an individual being homozygous for all three minority alleles would be calculated at one in one million. If we did not know that the true frequency was one in ten for the minority members, we might be persuaded to convict a minority suspect on the bases of the DNA match. *Cauthron*, 120 Wash. 2d at 903-04, 846 P.2d at 514; see also *DNA Technology*, *supra* note 3, at 11 (providing other hypothetical numbers).

47. See R.C. Lewontin & Daniel L. Hartl, *Population Genetics in Forensic DNA Typing* 254 Science 1745 (1991) (absence of population substructure cannot be assumed but must be proved empirically).

48. See Ranajit Chakraborty & Kenneth K. Kidd, *The Utility of DNA Typing in Forensic Work* 254 Science 1735 (1991).

By 1989, criminal cases and scientific articles had raised “a crescendo of questions”⁴⁹ concerning DNA evidence. Many of these questions concerned statistical calculations. In response to these and other concerns about DNA evidence, the National Research Council (NRC) of the National Academy of Sciences initiated a study in 1990 to address all aspects of forensic DNA typing and to provide specific recommendations for improvement. The study resulted in a report (NRC report) issued in April 1992 by the Council’s Committee on DNA Technology in Forensic Science (the NRC committee).⁵⁰

Although aware of the opposing views on the significance of population substructure and its effect on the product rule, the NRC committee chose to assume that population substructure may exist.⁵¹ The committee then proposed a method of calculating population statistics that accounts for substructure. The statistical method recommended by the committee is the ceiling principle.⁵² The ceiling principle is designed to yield conservative estimates that err in favor of criminal defendants. A conservative estimate is produced if allele frequencies used to calculate the significance of a match exceed allele frequencies actually observed in any of 15 to 20 reference population subgroups.⁵³ Using a higher allele frequency than what is actually observed increases the calculated probability that the DNA pattern from the crime scene sample and the suspect could also be shared by a random person. Until adequate samples from population subgroups have been collected for use in ceiling

49. *DNA Technology*, *supra* note 3, at vii.

50. *Id.*

51. *Id.* at 80 (assuming existence of population substructure “for the sake of discussion”).

52. *Id.* at 13.

53. *Id.* Thus, using the ceiling principle, the allele frequency used in the statistical calculation is either 1) the maximum frequency observed for that allele in a sample of at least 100 randomly selected persons from each of 15–20 relatively homogeneous subpopulations or 2) five percent, whichever is larger. *Id.* Suppose that one locus, composed of alleles *c* and *d*, has been studied in three population samples, with the following results:

	Population 1	Population 2	Population 3
Allele <i>c</i>	3 percent	4 percent	4 percent
Allele <i>d</i>	2 percent	15 percent	7 percent

The ceiling principle would assign ceiling values of 5 percent for allele *c* and 15 percent for allele *d*. The frequency for allele *c* is 5 percent, rather than 4 percent, to reflect the recommended lower bound of 5 percent. *Id.* at 83.

principle calculations, the committee recommended that a modified or interim ceiling principle be used.⁵⁴

Although the NRC study was intended to help settle controversy over such aspects of DNA evidence as probability statistics, the report actually has generated further debate.⁵⁵ The varied outcomes of subsequent judicial decisions demonstrate the NRC's failure to provide the final word on all aspects of DNA evidence, especially probability statistics.⁵⁶ After the study was published, some courts continued to rule DNA evidence admissible,⁵⁷ while others ruled it inadmissible.⁵⁸ Many appellate courts have remanded the admissibility of DNA evidence for further consideration by trial courts.⁵⁹ Several courts have indicated that either the ceiling principle or interim ceiling principle has received general acceptance in the scientific community.⁶⁰ Other courts have

54. *Id.* at 14–15. The allele frequency used in the interim ceiling principle calculation would be either 1) the 95-percent upper confidence limit on the maximum frequency observed among at least three ethnically or racially distinct databases, such as Caucasians, Hispanics, and Asians or 2) 10 percent, whichever is larger. *Id.* Use of the 95-percent upper confidence limit implies that the true allele frequency has only a 5-percent chance of exceeding the upper bound. *Id.* at 9.

55. The controversy following the report has led to the convening of another NRC committee for a second examination of the issues. B.S. Weir, Book Reviews, 53 *Am. J. Hum. Genet.* 1158, 1158 (1993).

56. Difference in outcomes is also affected by the fact that some courts use the *Frye* test, while others use the Federal Rules of Evidence approach. See *infra* note 67 and accompanying text, discussing the Federal Rules approach to admissibility.

57. See, e.g., *Fishback v. People*, 851 P.2d 884, 894 (Colo. 1993); *Nelson v. State*, 628 A.2d 69, 76 (Del. 1993) (DNA evidence admissible only with population statistics); *State v. Dykes*, 847 P.2d 1214, 1218 (Kan. 1993); *State v. Futch*, 860 P.2d 264, 270 (Or. Ct. App. 1993); *Springfield v. State*, 860 P.2d 435, 444, 448 (Wyo. 1993).

58. See, e.g., *State v. Bible*, 858 P.2d 1152, 1190 (Ariz. 1993) (statistics inadmissible); *People v. Barney*, 10 Cal. Rptr. 2d 731, 745 (Cal. Ct. App.), *rev. denied*, No. S023767, 1992 Cal. LEXIS 5924 (Cal. Nov. 25, 1992); *People v. Wallace*, 17 Cal. Rptr. 2d 721, 725 (Cal. Ct. App.), *rev. denied*, No. S032549, 1993 Cal. LEXIS 3381 (Cal. June 24, 1993); *Commonwealth v. Lanigan*, 596 N.E.2d 311, 317 (Mass. 1992); *State v. Anderson*, 853 P.2d 135, 146–47 (N.M. Ct. App.), *cert. granted*, 848 P.2d 531 (N.M. 1993).

59. See, e.g., *People v. Pizarro*, 12 Cal. Rptr. 2d 436, 461 (Cal. Ct. App. 1992), *rev. denied*, S019923, 1993 Cal. LEXIS 253 (Cal. Jan. 21, 1993); *United States v. Porter*, 618 A.2d 629, 644 (D.C. 1992); *State v. Houser*, 490 N.W.2d 168, 184 (Neb. 1992); *State v. Vandebogart*, 616 A.2d 483, 495 (N.H. 1992) (remanding specifically for hearing to determine whether NRC's ceiling principle is generally accepted).

60. *United States v. Bridgett*, 120 Daily Wash. L. Rptr. 1697, 1702 (Super. Ct. D.C. 1992) (stating that the NRC committee's conclusions could be equated with general acceptance in the relevant scientific communities); *State v. Alt*, 504 N.W.2d 38, 51 (Minn. Ct. App.), *rev. granted in part*, 505 N.W.2d 72 (Minn. 1993).

expressed hope for consensus on a conservative statistical methodology⁶¹ that would lead to admissibility of DNA evidence.

B. *The Frye Test for Admissibility of Scientific Evidence*

In deciding the admissibility of DNA evidence and other novel scientific evidence, Washington and many other states employ the *Frye* test, first articulated in a 1923 case concerning the admissibility of polygraph evidence.⁶² Courts employ the *Frye* test to ensure the trustworthiness of scientific theories, such as DNA typing, before allowing a jury to hear them. Impressed by the seeming infallibility of scientific evidence, jurors may overemphasize expert testimony based on scientific principles.⁶³ Under the *Frye* test, courts can admit novel scientific theories and techniques only after they have gained general acceptance within the relevant scientific community.⁶⁴ Once a jurisdiction's high court determines that evidence is admissible under *Frye*, other courts within the jurisdiction may admit that evidence without further hearings, unless new scientific evidence arises.⁶⁵

The Washington Supreme Court explicitly adopted the *Frye* test for the first time in *State v. Canaday*,⁶⁶ and in *Cauthron* the court renewed its adherence to *Frye*. The *Cauthron* court explicitly chose not to follow the less conservative relevance approach of the Federal Rules of Evidence.⁶⁷ It reasoned that, under *Frye*, courts are less likely to admit

61. *Barney*, 10 Cal. Rptr. 2d at 745 (stating that DNA evidence is likely to be admissible if statistics are calculated according to ceiling principle); *Porter*, 618 A.2d at 642 (finding it probable, in light of recent events, that a conservative consensus can be found); *Lanigan*, 596 N.E.2d at 316. *But see Wallace*, 17 Cal. Rptr. 2d at 725 (noting recent developments have shown general acceptance of the ceiling principle may not be easily achieved).

62. *Frye v. United States*, 293 F. 1013 (D.C. Cir. 1923).

63. Robert H. Aronson, *The Law of Evidence in Washington* § 702-9 (2d ed. 1993).

64. The *Frye* test is stated within the following much quoted passage of the *Frye* opinion:

Just when a scientific principle or discovery crosses the line between the experimental and demonstrable stages is difficult to define. Somewhere in this twilight zone the evidential force of the principle must be recognized, and while courts will go a long way in admitting expert testimony deduced from a well-recognized scientific principle or discovery, the thing from which the deduction is made *must be sufficiently established to have gained general acceptance in the particular field in which it belongs.*

Frye, 293 F. at 1014 (emphasis added).

65. *State v. Cauthron*, 120 Wash. 2d 879, 888 n.3, 879 P.2d 502, 506 n.3 (1993).

66. 90 Wash. 2d 808, 812-13, 585 P.2d 1185, 1188 (1978). The court implicitly adopted *Frye* in *State v. Woo*, 84 Wash. 2d 472, 473, 527 P.2d 271, 272 (1974).

67. *State v. Cauthron*, 120 Wash. 2d at 886, 846 P.2d at 505. Proponents of the Federal Rules approach maintain that the policies behind *Frye* are addressed by Rule 702 (requiring that expert testimony assist the trier of fact), Rule 703 (requiring that the facts or data be "of a type reasonably

questionable scientific evidence.⁶⁸ The court restricted the *Frye* analysis to the issue of whether or not the evidence being offered is based on an accepted theory and valid technique to implement that theory.⁶⁹ Under *Cauthron*'s characterization of *Frye*, a "significant dispute between qualified experts as to the validity of scientific evidence" precludes its admission.⁷⁰ The court held that whether an expert is qualified and whether expert testimony would be helpful to the trier of fact should be analyzed separately under Evidence Rule 702, making the *Frye* test a threshold inquiry.⁷¹ The separation is important, because it allowed the *Cauthron* court to hold that its standard of review for a trial court's *Frye* holding will be de novo, while maintaining an abuse of discretion standard for the Evidence Rule 702 ruling.⁷²

Applying the *Frye* standard for admissibility, the *Cauthron* court held that the scientific principle underlying DNA evidence and the RFLP method of DNA typing are generally accepted and therefore admissible.⁷³ Nonetheless, the court concluded that testimony of a match in *Cauthron*'s case could not be admitted. It held the significance of such testimony depended on probability statistics,⁷⁴ which the prosecution did not offer at trial.⁷⁵ Without probability statistics, the court found testimony of a match did not meet the *Frye* test, nor did it meet Evidence Rule 702's

relied upon by experts in the particular field"), and 403 (excluding evidence causing undue prejudice or confusion). See Aronson, *supra* note 63, at § 702-10. The U.S. Supreme Court has held that the *Frye* test was superseded by the adoption of the Federal Rules. *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, 113 S. Ct. 2786 (1993).

68. *Cauthron*, 120 Wash. 2d at 886 n.2, 846 P.2d at 505 n.2.

69. *Id.* at 889, 846 P.2d at 507.

70. *Id.* at 887, 846 P.2d at 505.

71. *Id.* at 890, 846 P.2d at 507. Eliminating the issue of general acceptance in the scientific community from Washington Evidence Rule 702 analysis overrules those Washington decisions which had included it as the second prong of a three-part Evidence Rule 702 analysis. See, e.g., *State v. Allery*, 101 Wash. 2d 591, 596, 682 P.2d 312, 315 (1984) (holding that admissibility of expert testimony depends on whether 1) the witness qualified as an expert, 2) the witness based her opinion on an explanatory theory generally accepted in the scientific community, and 3) the expert testimony would be helpful to the trier of fact).

72. *Cauthron*, 120 Wash. 2d at 885, 846 P.2d at 504-05. Under the de novo standard applied to the *Frye* inquiry, courts may look beyond evidence in the record to other cases and articles they find relevant. *Id.* at 887-88, 846 P.2d at 505-06.

73. *Id.* at 882, 846 P.2d at 503.

74. *Id.* at 906-07, 846 P.2d at 516 (quoting *DNA Technology*, *supra* note 3, at 74) ("To say that two patterns match, without providing any scientifically valid estimate . . . of the frequency with which such matches might occur by chance, is meaningless.").

75. *Id.* at 907, 846 P.2d at 515-16.

requirement that evidence be helpful to the trier of fact.⁷⁶ Therefore, the court reversed Cauthron's conviction and remanded the case to the trial court for further consideration of probability statistics.⁷⁷

Given that the prosecution in *Cauthron* rested without providing any evidence of population statistics,⁷⁸ the court was obligated to remand once it concluded that probability statistics are integral to testimony of a match. The court was unclear, however, on whether it was remanding for a full *Frye* hearing on the general acceptance of probability statistics or whether it was remanding simply for consideration of whether the probability statistics available in *Cauthron*, but not presented,⁷⁹ conformed to a particular accepted methodology, such as the ceiling principle. This lack of clarity is likely to produce confusion for courts in the future.

II. THE CAUTHRON DECISION PROVIDES MINIMAL GUIDANCE ON THE ADMISSIBILITY OF PROBABILITY STATISTICS

On the issue of when probability statistics meet the *Frye* test, courts and attorneys can interpret *Cauthron* two different ways. On one hand, *Cauthron* can be read as declining to decide whether any method of calculating probability statistics meets *Frye* and remanding for a full *Frye* hearing on that question. On the other hand, *Cauthron* also hints that the ceiling principle has found general acceptance. By suggesting such conflicting conclusions, the court failed to clarify the issues for the trial court and for other courts looking at *Cauthron* for guidance.⁸⁰

76. *Id.*

77. *Id.* at 909, 846 P.2d at 517.

78. *Id.* at 906, 846 P.2d at 516. Ellen Wijsman of the Department of Theoretical Genetics at the University of Washington testified at the *Frye* hearing that the statistical likelihood of two persons having the same DNA as the sample in question was one in 233 billion. Cauthron's counsel requested the statistical data be excluded at trial. The prosecutor "in effect, complied with this request," so the "probability of two persons having identical autorads never reached the jury." See Brief of Amicus Curiae Cellmark Diagnostics at 41-42, *State v. Cauthron*, (No. 58282-3) [hereinafter Amicus Brief].

79. See Amicus Brief, *supra* note 78.

80. In addition to Washington courts, courts in other states have looked to *Cauthron* for guidance. See, e.g., *State v. Bible*, 858 P.2d 1152, 1188 (Ariz. 1993) (citing *Cauthron* as confirming a lack of general acceptance for the Cellmark laboratory's statistical calculations); *State v. Alt*, 504 N.W.2d 38, 50 (Minn. Ct. App. 1993) (citing *Cauthron*'s discussion of the ceiling principle and its acceptance in "appropriate circumstances"), *rev. granted in part*, 505 N.W.2d 72 (Minn. Sept. 21, 1993).

Under one interpretation, the *Cauthron* court appears to have simply declined to decide when probability statistics meet the *Frye* test, leaving the issue for full *Frye* consideration on remand and in other trial courts. This interpretation—that the court intended to remand the issue of probability statistics for full *Frye* consideration—is suggested early in the *Cauthron* opinion. First, the court noted disagreement in the scientific community over the calculation of probability statistics.⁸¹ Second, the court concluded that expert testimony of a match was admitted in error, since it was not accompanied by statistical verification.⁸² Finally, the court remanded the case for reconsideration of the statistical evidence, in light of current scientific knowledge.⁸³ The court's highlighting of the disagreement in the scientific community over probability statistics and of current scientific knowledge on probability statistics suggests the court was requiring a full hearing on the general acceptance of probability statistics.

In addition, assuming the court declined to decide the general acceptance of probability statistics makes sense in light of the limited information available to an appellate court. An appellate court does not benefit from live expert testimony.⁸⁴ Furthermore, very few "post NRC report" cases at the time of *Cauthron* had held that any particular method of calculating probability statistics met *Frye*,⁸⁵ making it difficult for the *Cauthron* court to incorporate the work of other courts by reference. Interpreting *Cauthron* to require a full *Frye* hearing on probability statistics would be consistent with other *Frye* appellate decisions issued soon after the release of the NRC report and also remanding the probability statistics issue.⁸⁶

Embedded within the court's remand on the general acceptance of probability statistics, however, is a confusing reference to the ceiling principle. *Cauthron* seemed to answer its own remanded question (Is there a generally accepted method of calculating probability statistics?) by stating that the ceiling principle, preceded by the interim ceiling principle, has achieved general acceptance. The court noted the NRC's

81. *State v. Cauthron*, 120 Wash. 2d 879, 886, 846 P.2d 502, 505 (1993).

82. *Id.*

83. *Id.*

84. *Jones v. United States*, 548 A.2d 35, 43 (D.C. Cir. 1988), cited in *Cauthron*, 120 Wash. 2d at 887, 846 P.2d at 505.

85. One published trial court opinion held that the ceiling principle has general acceptance, equating the NRC's conclusions with general acceptance in the scientific community. *United States v. Bridgett*, 120 Daily Wash. L. Rptr. 1697, 1702 (Super. Ct. D.C. 1992).

86. See *supra* note 59.

adoption of the ceiling principle and the interim ceiling principle.⁸⁷ In the next sentence, the court admitted its lack of scientific expertise on the mechanics of the methodology, but wrote that adoption of the methodology by the committee indicates sufficient acceptance to satisfy *Frye* “in appropriate circumstances.”⁸⁸ The court was clearly referring to the ceiling principle and interim ceiling principle as the methodology accepted by the committee. Furthermore, the court earlier stated that, because of the broad range of scientists represented on the committee, acceptance by the committee indicates the general acceptance required by *Frye*.⁸⁹ Thus, the court concluded that the ceiling principle and interim ceiling principle are generally accepted and meet *Frye* in appropriate circumstances. Following this interpretation, trial courts might rely on *Cauthron* to accept probability statistics, and thus DNA evidence in its entirety, when the ceiling principle or something comparably conservative is employed.

The confusion produced by *Cauthron* is evidenced by the holdings of trial courts interpreting it. Shortly after the publication of *Cauthron*, at least one trial court in Washington conducted a full *Frye* hearing on the admissibility of DNA evidence.⁹⁰ In a memorandum disposition, the court interpreted *Cauthron* to have “directed an independent *Frye* consideration for [population statistics].”⁹¹ The court wrote:

I continue to believe that the most clear direction which *Cauthron* gave to the trial court was to proceed to determine whether there was a method of statistical calculation which could assume general acceptance in the scientific community. . . . And that is a *Frye* inquiry.⁹²

On the other hand, the trial court on remand in *Cauthron* relied on the supreme court’s decision to hold that the interim ceiling principle would satisfy the *Frye* test.⁹³ The trial court, however, held that any variation from the interim ceiling principle would require a *Frye* hearing.⁹⁴ It

87. *State v. Cauthron*, 120 Wash. 2d 879, 908, 846 P.2d 502, 517 (1993).

88. *Id.* at 908–09, 846 P.2d at 517.

89. *Id.* at 895, 846 P.2d at 510.

90. *State v. Hollis/DeFroe*, Nos. 92-1-04603-9 and 92-1-03699-8 (King County Super. Ct. 1993).

91. Transcript of Memorandum Opinion at 8, *State v. Hollis/DeFroe*, Nos. 92-1-04603-9 and 92-1-03699-8 (King County Super. Ct. 1993).

92. *Id.* at 9–10.

93. Court Order, Findings of Fact and Conclusions of Law Granting State’s Motion to Strike DNA *Frye* Hearing, *State v. Cauthron*, No. 88-1-01253-3 (Snohomish County Super. Ct. 1993).

94. Transcript of Pre-Trial Hearing at 5, *State v. Cauthron*, No. 88-1-01253-3 (Snohomish County Super. Ct. 1993).

rejected the State's farther reaching interpretation that any statistical method that was as conservative or more conservative than the interim ceiling principle would meet the *Frye* test.⁹⁵

The supreme court in *Cauthron* had to remand the issue of probability statistics, since statistics were not offered at trial. Still, because of its confusing discussion of the issue, other courts have little guidance on when the admission of probability statistics, and thus any DNA evidence, is appropriate.

III. COURTS SHOULD ADMIT DNA EVIDENCE WHEN SUPPORTED BY CONSERVATIVE PROBABILITY STATISTICS

Because *Cauthron* held that testimony of a match is inadmissible without probability statistics, lower court rulings on the admissibility of probability statistics will determine whether juries hear DNA evidence at all. After *Cauthron*, DNA evidence should be admitted when analyzed according to conservative probability statistics. Conservative methods of calculating probability statistics meet the *Frye* test. Comparisons to other forms of scientific evidence show that courts can address concerns about reliability and undue prejudice by admitting only conservative probability statistics, rather than by excluding DNA evidence altogether.

A. *Conservative Probability Statistics Provide the Courtroom Reliability Required by Frye*

As the U.S. Supreme Court noted in *Daubert v. Merrell Dow Pharmaceuticals, Inc.*, "there are important differences between the quest for truth in the courtroom and the quest for truth in the laboratory."⁹⁶ *Frye* does not require a perfect version of scientific evidence. Neither does it require absolute consensus within the scientific community.

1. *Frye Does Not Demand Certainty*

The *Frye* threshold test of admissibility does not require the exacting precision of an isolated laboratory.⁹⁷ Instead, it requires a version of

95. *Id.* at 9.

96. 113 S. Ct. 2786, 2798 (1993).

97. See *People v. Mohit*, 579 N.Y.S.2d 990, 993 (Westchester County Ct. 1992) (implying probability statistics should be admitted even if most scientists would consider the estimates too conservative); *Commonwealth v. Cumin*, 565 N.E.2d 440, 445 (Mass. 1991) (implying that DNA

scientific evidence that is generally accepted as reliable for the purpose of avoiding undue prejudice against a criminal defendant in the courtroom.⁹⁸ Presenting conservative probability statistics meets this standard by allowing the prosecution to bring important evidence to a jury's attention, yet eliminating undue prejudice by presenting statistics that err in favor of defendants.

That *Frye* does not require total certainty is shown by the fact that other forms of scientific evidence that are not absolutely precise have been admitted when their probative value outweighs problems of precision. For example, as with DNA evidence, breathalyzer test results must undergo scientific manipulation before they can be applied in a helpful way to a particular case. A formula must be used to convert breath-alcohol level to blood-alcohol level. The exact number to be used as a multiplier is debatable due to variability among individuals and within the same individual over time. Furthermore, moving from estimated blood concentration at the time of the test to a correct statement of the degree of intoxication during the time of driving increases the potential for imprecision, because individuals' alcohol tolerances, absorption rates, and clearance rates vary. Still, courts have admitted breathalyzer test results under *Frye* when authenticated and when satisfactory care is taken in collection and analysis.⁹⁹

Similarly, spectrographic voice identification, a technique analyzing the frequency of sound waves to identify a speaker, is subject to uncertainty. In a federal court of appeals case, the court noted that no voice is 100-percent unique, studies indicate that the spectrographic

evidence will be admitted when the scientific community can generally agree on a conservative estimate); *United States v. Porter*, 618 A.2d 629, 642 (D.C. 1992) (same).

98. Even if DNA evidence is generally accepted under the *Frye* threshold test, it must still be admissible under Evidence Rule 702 and Evidence Rule 403. These latter determinations, requiring that evidence assist the trier of fact and be more probative than prejudicial, depend on the facts of each case.

99. See *People v. Nieves*, 541 N.Y.S.2d 1008, 1010, 1013 (N.Y. City Crim. Ct. 1989) (stating that questions regarding conversion ratio accuracy go to weight); *State v. Richards*, 378 N.W.2d 259, 261 (S.D. 1985). In Washington, breathalyzer results were first admitted before the state's adoption of the *Frye* test. *State v. Baker*, 56 Wash. 2d 846, 852, 355 P.2d 806, 809-10 (1960).

The Washington Supreme Court gave its approval to the DataMaster breath analysis computer verifier, a replacement of the familiar breathalyzer, in *State v. Ford*, 110 Wash. 2d 827, 755 P.2d 806 (1988). Though the court did not refer to the *Frye* test explicitly, the case was decided after Washington's adoption of the test. Furthermore, the court used *Frye* language, holding that "the scientific principles of infrared spectroscopy upon which these machines operate are established and accepted. The . . . BAC Verifier [was] based upon those principles." See also *State v. Straka*, 116 Wash. 2d 859, 810 P.2d 888 (1991); *McCormick on Evidence* § 205(B) (John W. Strong gen. ed., 1992).

technique is subject to error, and no one had conducted studies involving females of the defendant's race.¹⁰⁰ Still, the court held that lack of certainty need not render the technique inadmissible under *Frye* when sufficient indicia of reliability are present.¹⁰¹ Finally, the Washington Supreme Court has permitted testimony under *Frye* that items of trace evidence, including hair, fibers, and paint chips, could have shared a common source.¹⁰² The court held that lack of certainty regarding microanalytic techniques employed went "to the weight to be given the testimony . . . because the scientific process . . . often allows no more certain testimony."¹⁰³

DNA evidence may carry a greater aura of certainty than other forms of evidence, even scientific evidence, but DNA evidence has survived a high enough degree of scrutiny to warrant that certainty. The undertaking of the NRC study¹⁰⁴ and the proliferation of scientific research on the subject of DNA evidence¹⁰⁵ demonstrate this scrutiny. The NRC's conclusion is clear: While the process of DNA typing for forensic purposes must undergo refinement, "[t]here is no need for a general moratorium on the use of the results of DNA typing either in investigation or in the courts."¹⁰⁶ As a comparison to the admissibility of other scientific evidence suggests, the probability statistics component of DNA evidence does not require absolute precision to produce reliable evidence, with a probative value that outweighs its capacity to unfairly prejudice a jury. In most cases, odds against a match being the result of a coincidence are extremely high, even when the most conservative statistical calculations are used.¹⁰⁷

100. *United States v. Smith*, 869 F.2d 348, 354 (7th Cir. 1989).

101. *Id.* at 352, 354.

102. *State v. Lord*, 117 Wash. 2d 829, 853, 822 P.2d 177, 192 (1991). *cert. denied*, 113 S. Ct. 164 (1992).

103. *Id.*

104. See *supra* note 50 and accompanying text.

105. See generally *infra* notes 127-33 and accompanying text.

106. *DNA Technology*, *supra* note 3, at x.

107. Eric S. Lander, *DNA Fingerprinting: The NRC Report*, 260 Science 1221 (1993) ("[A] looser standard will not significantly increase the power of forensic DNA typing, but it will likely provoke continued litigation that will hamper the use of this important and powerful criminalistic tool.").

In *Fishback*, the court stated that expert testimony of a one in 830 million probability, calculated according to the traditional product rule, might be one in 8.3 million by more conservative standards. 851 P.2d 884, 894 n.19 (Colo. 1993). While the difference between those two probabilities may be important for scientific purposes, either number gives more than a 99-percent certainty that a random person would not share the same DNA profile for legal purposes. *Id.* at 900 n.3 (Mullarkey, J., concurring).

2. *Frye Does Not Demand Consensus*

A lack of unanimity in the scientific community does not preclude the general acceptance required by *Frye*.¹⁰⁸ In fact, *Cauthron* specifically states that only a “significant” dispute between qualified experts precludes admission under *Frye*.¹⁰⁹ Other courts have held that *Frye* is not simply a process of counting scientific noses.¹¹⁰ In addition to looking at the existence of a controversy, courts may also look at the expertise and number of scientists involved in a dispute and the extent of the dispute.¹¹¹ Therefore, the fact that scientists disagree whether existing probability statistics methods produce conservative estimates¹¹² does not preclude admitting DNA evidence under *Frye*.

B. The Admission of Scientific Evidence Can Be Limited to Proper Circumstances

Comparisons to other scientific evidence indicate that the dual policies of avoiding undue prejudice and ensuring reliability, which underlie the *Frye* test, can be met by admitting scientific evidence only under proper circumstances, rather than by excluding it all together. With breathalyzer tests, for example, courts have required the state to prove that the machine was in proper working order, the chemicals used were proper, the operator was qualified, and the test was properly administered before test results are admissible.¹¹³ Spectrographic voice identification

In *Springfield*, an expert re-calculated probability statistics using the ceiling principle. Probabilities for the black database went from one in 150 million to one in 17 million and for the Indian database from one in 250,000 to one in 221,000. 860 P.2d 435, 438, 447 (Wyo. 1993); see also *United States v. Porter*, 618 A.2d 629, 642 (D.C. 1992) (stating that the odds of match occurring by chance are high even if most conservative statistics are used).

108. “The consensus required to justify novel scientific evidence need not, however, be universal, for there are often dissenters, even reputable dissenters, to what is scientifically valid.” Richard Lempert, *Some Caveats Concerning DNA as Criminal Identification Evidence: With Thanks to the Reverend Bayes*, 13 *Cardozo L. Rev.* 303, 336 (1991).

109. *State v. Cauthron*, 120 Wash. 2d 879, 887, 846 P.2d 502, 505 (1993).

110. *People v. Pizarro*, 12 Cal. Rptr. 2d 436, 448 (Cal. Dist. Ct. App. 1992), *rev. denied*, No. S019923, 1993 Cal. LEXIS 254 (Cal. Jan. 21, 1993); see also *People v. Mohit*, 579 N.Y.S.2d 990, 992 (Westchester County Ct. 1992) (“‘[C]ounting heads’ to determine a majority view is rarely feasible and can be of dubious value.”).

111. *People v. Axell*, 1 Cal. Rptr. 2d 411, 421 (Cal. Ct. App. 1991), *rev. denied* (1992).

112. See Jennifer R. Slimowitz and Joel E. Cohen, *Violations of the Ceiling Principle: Exact Conditions and Statistical Evidence*, 53 *Am. J. Hum. Genet.* 314 (1993).

113. *State v. Straka*, 116 Wash. 2d 859, 874–75, 810 P.2d 888, 895 (1991); see also *State v. Baker*, 56 Wash. 2d 846, 852, 355 P.2d 806, 809–10 (1960) (establishing foundational requirements

evidence, also subject to uncertainty, is admissible when the technique shows a low potential rate of error, proper maintenance of standards, careful application, and existence of "fail-safe characteristics."¹¹⁴ Similarly, the U.S. Supreme Court held that a per se rule excluding hypnotically aided testimony violated constitutional rights, including the right to testify on one's own behalf, when the circumstances of the testimony demonstrated reliability.¹¹⁵ The court indicated that such evidence should be admitted when the testimony is subject to verification by corroborating evidence and is audio or video recorded.¹¹⁶ Finally, psychological profile evidence has also been admitted when limited to appropriate circumstances. After deciding expert testimony on the behavior of battered women met the *Frye* test, the Washington Supreme Court, in *State v. Ciskie*, held that testimony of a behavior pattern was admissible only when rape was not indicated as a potential cause of the behavior.¹¹⁷ Though the expert could explain the victim's failure to leave the relationship or to complain to authorities, she could not use the phrase "rape trauma syndrome."¹¹⁸ These examples demonstrate that scientific evidence need not be excluded when it can be properly limited.

C. *Proper Circumstances for Admitting DNA Evidence*

As with other kinds of scientific evidence, the probability statistics element of DNA evidence can be limited to circumstances in which reliability is preserved and undue prejudice is avoided. Like properly limited breathalyzer results, voice identification evidence, hypnotically aided testimony, and psychological profile evidence, conservative probability statistics provide courtroom reliability and avoid undue prejudice. Since the NRC report, many scientists and courts have come to agree that existing statistical techniques produce conservative results, resolving uncertainties in favor of defendants.

One conservative method of estimating probability statistics is the counting rule. This method involves counting the occurrences of a DNA

in Washington); *State v. Richards*, 378 N.W.2d 259, 261 (S.D. 1985) (quoting *State v. Helmer*, 278 N.W.2d 808 (S.D. 1979)).

114. *United States v. Smith*, 869 F.2d 348, 352, 354 (7th Cir. 1989) (citing *United States v. Williams*, 583 F.2d 1194, 1198-99 (2d. Cir. 1978), *cert. denied*, 439 U.S. 1117 (1979)). Fail-safe characteristics are characteristics the variability of which will lead to different results. *Id.* at 352.

115. *Rock v. Arkansas*, 483 U.S. 44, 61-62 (1987).

116. *Id.*

117. 110 Wash. 2d 263, 279-80, 751 P.2d 1165, 1173-74 (1988).

118. *Id.* at 270 n.1, 751 P.2d at 1169 n.1.

pattern in a random sample of the appropriate population and then using classical statistical formulas to place upper and lower confidence limits on the estimate.¹¹⁹ The upper confidence limit of the frequency should be used in court.¹²⁰ Probability statistics produced by simple counting do not depend on theoretical independence assumptions, but simply on the comparison sample's having been randomly drawn from the appropriate population.¹²¹ Counting rule frequencies do not, however, take advantage of the full potential of the genetic approach.¹²² Because it is impossible or impractical to compile a large enough database to calculate a counting rule frequency much below one in 1,000, there is not sufficient empirical data on which to base a claim that such calculations are reliable or valid.¹²³

In Minnesota, courts admit only the statistical frequencies of individual loci (sites), provided they are calculated according to the ceiling principle.¹²⁴ These courts do not admit results of the product rule, the composite frequency of a match on all loci, for fear the jury would use such evidence as a measure of guilt or innocence.¹²⁵ By excluding results of the product rule, Minnesota seeks to avoid presenting an inaccurate calculation of the likelihood of a random match, such inaccuracy being due to lack of independence among loci, or linkage equilibrium.¹²⁶ This approach, however, does not have the same power as one that demonstrates the significance of a "match" at all loci tested.

119. *DNA Technology*, *supra* note 3, at 75.

If the pattern occurred in one of 100 samples, the estimated frequency would be one percent with an upper confidence limit of 4.7 percent. If the pattern occurred in 0 of 100 samples, the estimated frequency would be 0 percent, with an upper confidence limit of 3 percent. (The upper bound cited is the traditional 95-percent confidence limit, [the use of which] implies that the true frequency has only a 5-percent chance of exceeding the upper bound.)

Id. at 76.

120. *See supra* notes 54 and 119 for an explanation of upper confidence limit.

121. *DNA Technology*, *supra* note 3, at 76.

122. *Id.* While reference samples are being collected for use in the ceiling principle, the NRC recommends reporting probability statistics according to both the counting principle and the interim ceiling principle. Factfinders should be told when, according to the counting principle, the lab finds no match with any sample in a total data bank of N persons. *Id.* at 95. *People v. Barney*, 10 Cal. Rptr. 2d 731, 745 (Cal. Ct. App. 1992), *rev. denied*, No. S028767, 1992 Cal. LEXIS 5924 (Cal. Nov. 25, 1992).

123. *DNA Technology*, *supra* note 3, at 10.

124. *State v. Alt*, 504 N.W.2d 38, 51 (Minn. Ct. App.), *rev. granted in part*, 505 N.W.2d 72 (Minn. Sept. 21, 1993) (clarifying that "the only DNA frequency evidence to be admitted at trial is the population frequency evidence of the individual bands").

125. *Id.* at 53 n.25.

126. *Id.* at 52 n.23.

Furthermore, juries might simply multiply the individual frequencies and calculate the composite frequency themselves.

Finally, the ceiling principle and interim ceiling principle methods may be used to calculate probability statistics. While some controversy over the precise accuracy of these methods remains,¹²⁷ many population geneticists and statisticians seem to agree at least that they produce a conservative result.¹²⁸ Dr. Eric Lander,¹²⁹ in an affidavit filed in Washington superior court, states:

Estimating population frequencies in accordance with the interim ceiling principle is a standard of practice so conservative that no serious scientific argument based on data could be made to say that such an estimate could be biased against the defendant.¹³⁰

In fact, much of the dispute over DNA evidence lies not over whether probability statistics like the ceiling and interim ceiling principle are conservative enough, but over whether they are too conservative.¹³¹

Many scientists and geneticists even agree that the conventional product rule (a method lacking ceiling principle safeguards) is conservative, because the effects of population substructure are negligible and would rarely have a negative effect on a defendant.¹³²

127. Concern about the ceiling principle centers around what some call a lack of scientific basis or an arbitrariness to the NRC's proposal. See B. Devlin et al., *Statistical Evaluation of DNA Fingerprinting: A Critique of the NRC's Report*, 259 Science 748, 837 (1993).

128. "We agree . . . [the ceiling principle] is extremely conservative." *Id.* Even two of the original critics of DNA statistical analysis, Hartl and Lewontin, write that the interim ceiling principle is conservative. Daniel L. Hartl and Richard C. Lewontin, *DNA Fingerprinting Report*, 260 Science 473, 474 (1993) ("Everyone agrees [the interim ceiling principle] is conservative, and some believe that it is too conservative."). *Contra* Jennifer R. Slimowitz and Joel E. Cohen, *Violations of the Ceiling Principle: Exact Conditions and Statistical Evidence*, 53 Am. J. Hum. Genet. 314, 316 (1993) (suggesting that the ceiling principle could fail to be conservative under simplified and highly artificial conditions).

129. In 1989, Dr. Lander was one of the first to express concern over the adequacy of population databases and the effect of population substructuring on probability statistics. Eric Lander, *DNA Fingerprinting on Trial*, 339 Nature 501, 501-05 (1989). Lander is an associate professor of biology at the Massachusetts Institute of Technology and director of the MIT Center for Genome Research, with expertise in human genetics, molecular biology, population genetics, mathematics, and statistics. *DNA Technology*, *supra* note 3, at 175.

130. Affidavit of Dr. Eric S. Lander, *State v. Dyer*, No. 93-1-00489-0 (King County Super. Ct. September 20, 1993).

131. Peter Aldhous, *Geneticists Attack NRC Report as Scientifically Flawed*, 259 Science 755, 755 (1993) (pointing to a "rash of papers" from population geneticists and statisticians which argue the NRC, which proposed the ceiling and interim ceiling principle "erred too far on the side of caution in trying to address concerns"); see also Hartl, *supra* note 128.

132. *DNA Technology*, *supra* note 3, at 12.

Others believe there is no method that will absolutely guarantee conservative estimated match probabilities when there are small departures from Hardy-Weinberg equilibrium or linkage equilibrium.¹³³ Still, according to some of the same scientists, such departures are unlikely to seriously compromise most estimates derived from the interim ceiling principle.¹³⁴

While the weight to be given probability statistics can be debated, conservative probability statistics should be admissible under the *Frye* threshold test. Conservative estimates satisfy *Frye*'s courtroom test of reliability by providing estimates that avoid undue prejudice against defendants. Indeed, the possibility of a match being the result of coincidence is remote, even when the most conservative statistical calculations are used.¹³⁵

Because conservative probability statistics provide a way of preserving reliability and minimizing undue prejudice, juries should know that "there was a match and that the possibility of the perpetrator being someone other than the defendant is remote, even if it is difficult to say precisely how remote."¹³⁶ Juries will not be irreversibly mesmerized

The discriminating power of DNA profiles is so high, and the chance of a fortuitous match so low, that the precision with which a frequency is estimated is rarely, if ever, going to have an unnecessarily prejudicial effect on the decisions of a court. Each of us has demonstrated this last point by simulating cases in which data bases of the wrong ethnic group are deliberately used.

B.S. Weir and I.W. Evett, *Reply to Lewontin*, 52 Am. J. Hum. Genet. 206, 206 (1993) (also stating that concerns about the effect of population substructure has academic validity, but when experiments are carried out on real data, "the practical effects of lack of independence" are "minor"); see also, I.W. Evett et al., *An Illustration of the Advantages of Efficient Statistical Methods for RFLP Analysis in Forensic Science*, 52 Am. J. Hum. Genet. 498, 504 (1993); Ranajit Chakraborty et al., *Evaluation of Standard Error and Confidence Interval of Estimated Multilocus Genotype Probabilities, and Their Implications in DNA Forensics*, 52 Am. J. Hum. Genet. 60, 69 (1993) (stating that "irrespective of the racial/ethnic origin of individuals, most five-locus DNA profiles have a frequency no larger than 1 in 1 million, in fixed-bin data"); I.W. Evett, *DNA Statistics: Putting the Problems Into Perspective*, 156 Justice Peace 583, 583-86 (1992).

133. Krane, *supra* note 21, at 10,587.

134. *Id.*

135. See *supra* note 107.

136. *People v. Mohit*, 579 N.Y.S.2d 990, 993 (Co. Ct. 1992). "[T]he fact that it is difficult, given the present state of knowledge, to be precise, does not mean that conservative methods cannot be used." *Id.* at 999.

by probability statistics, because cross-examination can uncover flaws and uncertainties in the statistics presented.¹³⁷

Without a doubt, the admissibility of probability statistics in DNA evidence must be determined according to a high standard of science and a high standard of justice. Conservative methods of calculating probability statistics, like the ceiling and interim ceiling principle, meet these standards. Such conservative methods provide powerful evidence,¹³⁸ and a strong argument can be made that the ceiling and interim ceiling principles, in particular, are generally accepted as erring in favor of defendants.¹³⁹ While scientists may disagree on the best method of calculating probability statistics, this disagreement should not preclude the admission of powerful forensic evidence when uncertainties are resolved in favor of defendants.

IV. CONCLUSION

The *Cauthron* court reaffirmed and clarified the *Frye* test in the state of Washington and held that the underlying theory of DNA evidence and the RFLP method of DNA typing are generally accepted and admissible. When it came to the admissibility of probability statistics, however, the *Cauthron* decision provided unclear guidance, leaving this pivotal issue unresolved for future courts. Washington courts should fill this void by admitting the valuable and powerful tool of DNA evidence when conservative probability statistics are used.

137. Attorneys, for example, could ask experts when the statistical method might fail to be conservative and whether those circumstances were present in calculating the probability statistics at issue.

138. See *supra* note 107.

139. See *supra* notes 128–34 and accompanying text.